

Appendix E

Ground Water Monitoring Results by Associated Earth Sciences, Inc.

Appendix E was included in the DEIS and is incorporated by reference in the FEIS with the following addendum.

TERRA ASSOCIATES, Inc.

Consultants in Geotechnical Engineering, Geology
and
Environmental Earth Sciences

MEMO

To: Steve Hall
Jones and Stokes Associates, Inc.

June 19, 2000
Project No. T-4169

From: Charles R. Lie
Terra Associates, Inc.

Subject: Groundwater Quality Summary
Lone Star Property
Maury Island
King County, Washington

Dear Steve:

This memo contains a summary of the results of the first four quarters of groundwater sampling and chemical analysis at the Lone Star Property site. The groundwater samples were obtained by AEIS from Monitoring Wells OBW-6, OBW-7 and OBW-9. Dedicated pumps in each of the monitoring wells are used to obtain the groundwater samples. The groundwater samples are analyzed for selected parameters at the laboratory of Amtest in Redmond, Washington.

The results of the groundwater testing is summarized on the attached tables. The tabulated data has been taken from copies of the laboratory reports for each well. Each table includes the following:

- Groundwater criteria from Implementation Guidance for the Groundwater Quality Standards, Ecology Publication No. 96-02, dated April 1996.
- Cleanup Values from the Model Toxics Control Act using Method A and, where there is no Method A cleanup value, Method B values contained in the Cleanup Levels and Risk Calculations (CLARC II), by Ecology, dated February 1996.
- Maximum Contaminant Levels from the drinking water regulations, Chapter 246-290 WAC.

The tables show the water samples from the monitoring wells exceed the drinking water standards for turbidity and color. These are the results of well development and sampling procedures and are not expected to reflect degraded groundwater. To reduce these values, either the monitoring wells could be given additional development efforts, or the pumps could be run at a lower rate to reduce turbidity.

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Mr. Steve Hall
June 19, 2000

The levels of arsenic exceed the groundwater criteria value. The groundwater criteria were created to implement the Groundwater Quality Standards (Chapter 173-200, WAC). These standards were created to promote consistent statewide implementation of the standards for all activities that have a potential to degrade groundwater quality. The standards are a regulatory approach to protect and preserve groundwater quality.

The groundwater criteria presented in the Ecology Implementation Guidance for the Groundwater Quality Standards is 0.05 mg/liter (0.00005 mg.liter). However, WAC 173-200-050 (3)9B)(II) states "when the background water quality exceeds a criterion, the enforcement limit at the point of compliance shall not exceed the background ground water quality for that contaminant."

The levels of arsenic in the groundwater appear to represent background water quality for this area. Two of the wells are clearly in an upgradient position on the site. The standards recognize that the permittee (applicant) should not be held responsible for groundwater quality that was inherited. However, increases in the levels of arsenic present above background levels would not be allowed.

We trust this memo adequately summarizes the results of the first four quarters of groundwater quality monitoring at the site. Please call if you have any questions.



Chuck Lie

Encl: Tables 1 through 3 – Summary of Groundwater Data

Project No. T-4169
Page No. 2

Table 1
Summary of Groundwater Data
Monitoring Well OBW-6

Water Quality Test (1) Parameters	Groundwater Quality Criteria (2)	Clean up Levels for Groundwater (3)	Drinking Water Levels (4)	Monitoring Well / Sample Date			
				OBW-6 02/19/99 (1)	OBW-6 05/18/99 (1)	OBW-6 08/31/99 (1)	OBW-6 11/18/99 (1)
Conventional				11.0	12.0	13.2	12.2
Temperature Field	NE (5)	NE (5)	NE (5)	7.5	7.4	7.4	7.6
PH Field	6.5 - 8.5	NE (5)	NE (5)	140	140	169	181
Conductivity (μ S/cm) Field	NE (5)	NE (5)	700 μ mhos/cm	..	3.36	1.96	2.1
Turbidity (NTU) Field	1 NTU	NE (5)	NE (5)	6.9	7.3	7.4	7.4
PH	6.5 - 8.5	NE (5)	NE (5)	48	46	51	43
Alkalinity 3 (mg/L)	NE (5)	NE (5)	NE (5)	<1	<1	<1	<1
Total Organic Carbon (mg/L)	NE (5)	NE (5)	NE (5)	3.4	4.4	4.9	5.6
Chloride (mg/L)	NEL	NE (5)	250 mg/L	130	140	160	160
Conductivity (μ S/cm)	NE (5)	NE (5)	700 μ mhos/cm	10	15	15	20
Color (CU)	15 color units	NE (5)	15 color units	20	<0.005	<0.005	<0.005
Total Cyanide (mg/L)	0.2 mg/L	0.32 mg/L (Method B)	0.2 mg/L	<0.005	<0.1	0.12	<0.1
Fluoride (mg/L)	4 mg/L	NE (5)	4.0 mg/L	0.09	61	53	58
Hardness (mg/L)	NE (5)	NE (5)	NE (5)	49	0.002	0.2	<0.1
Nitrate as Nitrogen (mg/L)	10 mg/L	NE (5)	10.0 mg/L	0.004	0.35	0.200	<0.1
Nitrate (mg/L)	10	25.6 mg/L (Method B)	NE (5)	0.95	<0.02	<0.1	<0.1
Nitrite (mg/L)	1.0	1.6 mg/L (Method B)	NE (5)	<0.25	<1	<1	<1
Total Oil & Grease (mg/L)	NE (5)	NE (5)	NE (5)	<1	<1	<1	<1
Total Petroleum Hydrocarbons (mg/L)	NE (5)	1 mg/L (Method A)	NE (5)	<1	<1	2	1
Total Suspended Solids (mg/L)	NE (5)	NE (5)	NE (5)	1	21	25	23
Sulfate (mg/L)	250 mg/L	NE (5)	250 mg/L	13	<0.25	<0.05	<0.05
Surfactants (mg/L)	NE (5)	NE (5)	NE (5)	0.08	0.6	4.1	3.5
Turbidity (NTU)	1 NTU	NE (5)	NE (5)	6.1			
Total Metals (mg/L)				0.06	0.06	<0.01	<0.01
Aluminum	NE (5)	NE (5)	NE (5)	0.006	<0.001	<0.001	<0.001
Antimony	0.006 mg/L	NE (5)	0.006 mg/L	<0.001	0.002	0.001	0.002
Arsenic	0.00005 mg/L	0.005 mg/L (Method A)	0.05 mg/L	0.005	0.007	0.008	0.0056
Barium	2.0 mg/L	1.12 mg/L (Method B)	2.0 mg/L	0.005	<0.0002	<0.0002	<0.0002
Beryllium	0.004 mg/L	0.00002 mg/L (Method B)	0.004 mg/L	<0.0002	6.7	6.9	8
Calcium	NE (5)	NE (5)	NE (5)	0.003	<0.002	<0.0005	<0.0005
Cadmium	0.005 mg/L	0.005 mg/L (Method A)	0.005 mg/L	<0.006	<0.006	<0.001	<0.004
Chromium (total)	0.1 mg/L	0.05 mg/L (Method A)	0.1 mg/L	0.016	<0.002	<0.001	<0.001
Copper	1.0 mg/L	0.592 mg/L (Method B)	1.3 mg/L (5)	0.77	0.78	0.86	0.92
Iron	0.3 mg/L	NE (5)	0.3 mg/L	<0.0008	<0.0002	<0.0002	<0.0002
Mercury	0.002 mg/L	0.002 mg/L (Method A)	0.002 mg/L	7.8	9.9	8.7	9.4
Magnesium	NE (5)	NE (5)	NE (5)	0.03	0.047	0.038	0.051
Manganese	0.05 mg/L	2.24 mg/L (Method B)	0.05 mg/L	6.2	8.7	5.7	7.1
Sodium	NE (5)	NE (5)	20 mg/L (5)	<0.01	<0.01	<0.005	<0.005
Nickel	0.1 mg/L	NE (5)	0.1 mg/L	<0.001	<0.001	<0.001	0.001
Lead	0.05 mg/L	0.005 mg/L (Method A)	0.015 mg/L (5)	<0.001	<0.001	<0.001	0.001
Selenium	0.05 mg/L	0.08 mg/L (Method B)	0.05 mg/L	<0.001	<0.001	<0.001	<0.001
Silver	0.1 mg/L	0.08 mg/L (Method B)	0.1 mg/L	<0.01	<0.01	<0.01	<0.01
Thallium	0.002 mg/L	NE (5)	0.002 mg/L	<0.001	<0.001	<0.001	<0.001
Zinc	5.0 mg/L	4.8 mg/L (Method B)	5.0 mg/L	0.038	0.037	0.048	0.039
Explanation:				(5) MCLs not established for copper, lead, and sodium but EPA has established Action Levels of 1.3 mg/L for copper and 0.015 mg/L for lead, which are applied to the highest concentration in 10% of all samples collected from the distribution system. The EPA has also established a recommended level of 20 mg/L for sodium as a level of concern for those consumers that may be restricted for daily sodium intake in their diets.			
(1) Units in mg/L unless otherwise noted.				(6) None Established.			
(2) Ground Water Quality Criterion based on standards outlined in WAC 173-200-040(3).							
(3) Method A Cleanup Levels for Ground Water based on standards outlined in Chapter 173-340 WAC. If no value established for Method A, then value given for Method B. (Values converted from μ g/L to mg/L).							
(4) Maximum Contaminant Levels for drinking water outlined in Chapter 246-290-310 WAC.							

Table 2
Summary of Groundwater Data
Monitoring Well OBW-7

Monitoring Well OBW-7				Monitoring Well / Sample Date			
Water Quality Test (1) Parameters	Groundwater Quality Criteria (2)	Clean up Levels for Groundwater (3)	Drinking Water Levels (4)	OBW-7 02/19/99 (1)	OBW-7 05/18/99 (1)	OBW-7 08/31/99 (1)	OBW-7 11/18/99 (1)
Conventionals	NE (5)	NE (5)	NE (5)	12.5	15.0	16.6	13.9
Temperature Field	6.5 - 8.5	NE (5)	NE (5)	7.1	7.4	7.3	7.5
PH Field	NE (5)	NE (5)	700 umhos/cm	260	250	176	246
Conductivity (µs/cm) Field	1 NTU	NE (5)	NE (5)	--	11.7	1.14	1.2
Turbidity (NTU) Field	6.5 - 8.5	NE (5)	NE (5)	7.1	7.6	7.3	7.4
PH	NE (5)	NE (5)	NE (5)	82	86	84	77
Alkalinity 3 (mg/L)	NE (5)	NE (5)	NE (5)	<1	<1	<1	<1
Total Organic Carbon (mg/L)	NE (5)	NE (5)	250 mg/L	10.0	9.9	9.6	10.0
Chloride (mg/L)	NE (5)	NE (5)	700 umhos/cm	250	240	260	270
Conductivity (µs/cm)	16 color units	NE (5)	15 color units	20	35	5	10
Color (CU)	0.2 mg/L	0.32 mg/L (Method B)	0.2 mg/L	<0.005	<0.005	<0.005	<0.005
Total Cyanide (mg/L)	4 mg/L	NE (5)	4.0 mg/L	0.07	<0.1	<0.1	<0.1
Fluoride (mg/L)	NE (5)	NE (5)	NE (5)	100	100	100	100
Hardness (mg/L)	10 mg/L	NE (5)	10.0 mg/L	0.026	0.022	4.3	<0.1
Nitrate as Nitrogen (mg/L)	10	25.6 mg/L (Method B)	NE (5)	5.000	4.600	4.3	5.6
Nitrate (mg/L)	1.0	1.6 mg/L (Method B)	NE (5)	<0.25	<0.2	<0.1	<0.1
Nitrite (mg/L)	NE (5)	NE (5)	NE (5)	<1	<1	<1	<1
Total Oil & Grease (mg/L)	NE (5)	1 mg/L (Method A)	NE (5)	<1	<1	<1	<1
Total Petroleum Hydrocarbons (mg/L)	NE (5)	NE (5)	NE (5)	2	4	1	1
Total Suspended Solids (mg/L)	250 mg/L	NE (5)	250 mg/L	21	26	25	24
Sulfate (mg/L)	NE (5)	NE (5)	NE (5)	0.15	0.62	<0.05	<0.05
Surfactants (mg/L)	1 NTU	NE (5)	NE (5)	6.7	16	1.6	1.8
Turbidity (NTU)	NE (5)	NE (5)	NE (5)	0.02	0.04	<0.01	<0.01
Total Metals (mg/L)	0.006 mg/L	0.005 mg/L (Method A)	0.005 mg/L	<0.001	<0.001	<0.001	<0.001
Aluminum	0.00005 mg/L	1.12 mg/L (Method B)	2.0 mg/L	0.002	0.001	0.001	0.002
Antimony	0.004mg/L	0.00002 mg/L (Method B)	0.004 mg/L	<0.0002	<0.0002	<0.0002	<0.0002
Arsenic	NE (5)	NE (5)	NE (5)	15	15	15	16
Barium	0.005 mg/L	0.005 mg/L (Method A)	0.005 mg/L	<0.002	<0.002	<0.001	<0.001
Beryllium	1.0 mg/L	0.592 mg/L (Method B)	1.3 mg/L (5)	0.017	<0.002	<0.001	<0.001
Copper	0.3 mg/L	NE (5)	0.3 mg/L	0.88	4.8	0.43	0.27
Iron	0.002 mg/L	0.002 mg/L (Method A)	0.002 mg/L	<0.0008	<0.0002	<0.0002	<0.0002
Mercury	NE (5)	NE (5)	NE (5)	16	16	16	15
Magnesium	0.05 mg/L	2.24 mg/L (Method B)	0.05 mg/L	0.07	0.13	0.057	0.047
Manganese	NE (5)	NE (5)	20 mg/L (5)	8.7	9.1	8	9.8
Sodium	0.1 mg/L	NE (5)	0.1 mg/L	<0.01	<0.01	<0.005	<0.005
Nickel	0.05 mg/L	0.005 mg/L (Method A)	0.015 mg/L (5)	0.001	<0.001	<0.001	<0.001
Lead	0.05 mg/L	0.08 mg/L (Method B)	0.05 mg/L	<0.001	<0.001	<0.001	<0.001
Selenium	0.1 mg/L	0.08 mg/L (Method B)	0.1 mg/L	<0.01	<0.01	<0.01	<0.01
Silver	0.002 mg/L	NE (5)	0.002 mg/L	<0.001	<0.001	<0.001	<0.001
Thallium	5.0 mg/L	4.8 mg/L (Method B)	5.0 mg/L	0.06	0.045	0.037	0.027
Zinc							
Explanation: (1) Units in mg/L unless otherwise noted. (2) Ground Water Quality Criterion based on standards outlined in WAC 173-200-040(3). (3) Method A Cleanup Levels for Ground Water based on standards outlined in Chapter 173-340 WAC. If no value established for Method A, then value given for Method B. (Values converted from µg/L to mg/L). (4) Maximum Contaminant Levels for drinking water outlined in Chapter 246-290-310 WAC.				(5) MCLs not established for copper, lead, and sodium but EPA has established Action Levels of 1.3 mg/L for copper and 0.015 mg/L for lead, which are applied to the highest concentration in 10% of all samples collected from the distribution system. The EPA has also established a recommended level of 20 mg/L for sodium as a level of concern for those consumers that may be restricted for daily sodium intake in their diets. (5) None Established.			

Table 3
Summary of Groundwater Data
Monitoring Well OBW-9

Monitoring Well OBW-9				Monitoring Well / Sample Date			
Water Quality Test (1) Parameters	Groundwater Quality Criteria (2)	Clean up Levels for Groundwater (3)	Drinking Water Levels (4)	OBW-9 02/19/99 (1)	OBW-9 05/18/99 (1)	OBW-9 08/31/99 (1)	OBW-9 11/18/99 (1)
Conventionals							
Temperature Field	NE (5)	NE (5)	NE (5)	12.0	14.0	14.7	12.8
PH Field	6.5 – 8.5	NE (5)	NE (5)	7.5	7.8	7.9	8.3
Conductivity (µs/cm) Field	NE(5)	NE (5)	700 umhos/cm	190	190	183	192
Turbidity (NTU) Field	1 NTU	NE (5)	NE (5)	--	1.71	2.4	2.41
PH	6.5 – 8.5	NE (5)	NE (5)	7.6	7.9	7.5	7.9
Alkalinity 3 (mg/L)	NE (5)	NE (5)	NE (5)	94	94	93	92
Total Organic Carbon (mg/L)	NE (5)	NE (5)	NE (5)	<1	<1	<1	<1
Chloride (mg/L)	NEL	NE (5)	250 mg/L	3.3	3.7	4.0	3.9
Conductivity (µs/cm)	NE (5)	NE (5)	700 umhos/cm	190	190	190	200
Color (CU)	15 color units	NE (5)	15 color units	10	5	10	15
Total Cyanide (mg/L)	0.2 mg/L	0.32 mg/L (Method B)	0.2 mg/L	<0.005	<0.005	<0.005	<0.005
Fluoride (mg/L)	4 mg/L	NE (5)	4.0 mg/L	0.13	<0.1	<0.16	<0.1
Hardness (mg/L)	NE(5)	NE (5)	NE (5)	80	87	81	84
Nitrate as Nitrogen (mg/L)	10 mg/L	NE (5)	10.0 mg/L	0.001	0.002		<0.1
Nitrate (mg/L)	10	25.6 mg/L (Method B)	NE (5)	<0.25	<0.2	<0.1	<0.1
Nitrite (mg/L)	1.0	1.6 mg/L (Method B)	NE (5)	<0.25	<0.2	<0.1	<0.1
Total Oil & Grease (mg/L)	NE (5)	NE (5)	NE (5)	<1	<1	<1	<1
Total Petroleum Hydrocarbons (mg/L)	NE (5)	1 mg/L (Method A)	NE (5)	<1	<1	<1	<1
Total Suspended Solids (mg/L)	NE (5)	NE (5)	NE (5)	1	<1	<1	<1
Sulfate (mg/L)	250 mg/L	NE (5)	250 mg/L	10	12	12	11
Surfactants (mg/L)	NE (5)	NE (5)	NE (5)	0.13	0.18	<0.05	<0.05
Turbidity (NTU)	1 NTU	NE (5)	NE (5)	0.78	1.5	1.4	1.2
Total Metals (mg/L)							
Aluminum	NE (5)	NE (5)	NE (5)	<0.01	0.05	<0.01	<0.01
Antimony	0.006 mg/L	NE (5)	0.006 mg/L	<0.001	<0.001	<0.001	<0.001
Arsenic	0.00005 mg/L	0.005 mg/L (Method A)	0.05 mg/L	0.004	0.005	0.002	0.004
Barium	2.0 mg/L	1.12 mg/L (Method B)	2.0 mg/L	0.008	0.01	0.012	0.011
Beryllium	0.004mg/L	0.00002 mg/L (Method B)	0.004 mg/L	<0.0002	<0.0002	<0.0002	<0.0002
Calcium	NE (5)	NE (5)	NE (5)	15	15	15	15
Cadmium	0.005 mg/L	0.005 mg/L (Method A)	0.005 mg/L	<0.002	<0.002	<0.0005	<0.0005
Chromium (total)	0.1 mg/L	0.05 mg/L (Method A)	0.1 mg/L	<0.006	<0.006	<0.001	<0.001
Copper	1.0 mg/L	0.592 mg/L (Method B)	1.3 mg/L (5)	0.006	0.002	<0.001	<0.001
Iron	0.3 mg/L	NE (5)	0.3 mg/L	0.13	0.29	0.3	0.2
Mercury	0.002 mg/L	0.002 mg/L (Method A)	0.002 mg/L	<0.0004	<0.0002	<0.0002	<0.0002
Magnesium	NE (5)	NE (5)	NE (5)	10	12	11	11
Manganese	0.05 mg/L	2.24 mg/L (Method B)	0.05 mg/L	0.23	0.1	0.077	0.12
Sodium	NE (5)	NE (5)	20 mg/L (5)	6.8	7.2	6.8	8.1
Nickel	0.1 mg/L	NE (5)	0.1 mg/L	<0.01	<0.01	<0.005	<0.005
Lead	0.05 mg/L	0.005 mg/L (Method A)	0.015 mg/L (5)	<0.001	<0.001	<0.001	0.002
Selenium	0.05 mg/L	0.08 mg/L (Method B)	0.05 mg/L	<0.001	<0.001	<0.001	<0.001
Silver	0.1 mg/L	0.08 mg/L (Method B)	0.1 mg/L	<0.01	<0.01	<0.01	<0.01
Thallium	0.002 mg/L	NE (5)	0.002 mg/L	<0.001	<0.001	<0.001	<0.001
Zinc	5.0 mg/L	4.8 mg/L (Method B)	5.0 mg/L	<0.002	0.012	0.015	0.002
Explanation: (1) Units in mg/L, unless otherwise noted. (2) Ground Water Quality Criterion based on standards outlined in WAC 173-200-040(3). (3) Method A Cleanup Levels for Ground Water based on standards outlined in Chapter 173-340 WAC. If no value established for Method A, then value given for Method B. (Values converted from µg/L to mg/L). (4) Maximum Contaminant Levels for drinking water outlined in Chapter 246-290-310 WAC.				(5) MCLs not established for copper, lead, and sodium but EPA has established Action Levels of 1.3 mg/L for copper and 0.015 mg/L for lead, which are applied to the highest concentration in 10% of all samples collected from the distribution system. The EPA has also established a recommended level of 20 mg/L for sodium as a level of concern for those consumers that may be restricted for daily sodium intake in their diets. (6) None Established.			